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| **Lesson Title: Kinetic and Potential Energy** |
| **Subject area / course / grade level: 4th – 6th** |
| **Introduction:** Energy is defined as the ability to do work. When the work is actually being done, we term the energy as “kinetic.” When the work is waiting to be done, or resting, the potential for work to be performed, we term the energy as “potential.” Kinetic energy is the energy of motion; potential energy comes from work having been done on an object, which was then stored. |
| **Lesson Length: 2 days for 1 hour block** |
| **Materials: Meter sticks, variety of bouncy balls, graph paper, pencil, interactive science notebook, and lab guide handout.** |
| **Lesson Overview: Students will be able to recognize the relationship between potential and kinetic energy by developing experimental procedures and following the scientific method.** |
| **Tennessee Standards:**   * **GLE 0507.Inq.1** Explore different scientific phenomena by asking questions, making logical predictions, planning investigations, and recording data. * **GLE 0507.Inq.2** Select and use appropriate tools and simple equipment to conduct an investigation. * **GLE 0507.Inq.3** Organize data into appropriate tables, graphs, drawings, or diagrams. * **GLE 0507.Inq.4** Identify and interpret simple patterns of evidence to communicate the findings of multiple investigations. * **GLE 0507.Inq.6** Compare the results of an investigation with what scientists already accept about this question. * **SPI 0507.10.1** Differentiate between potential and kinetic energy. * **SPI 0407.11.1** Describe the position of an object relative to fixed reference points. * **SPI 0607.10.2** Interpret the relationship between potential and kinetic energy. |
| **Lesson objective(s):**   * **The student will investigate the relationship between potential and kinetic energy.** * **The student will design procedures to test five different hypotheses.** * **The student will analyze data and results from experiment.** * **The student will compare and contrast data and results with the other groups.** * **The student will design a graph to represent their data.** |
| **ENGAGEMENT**   1. Brainstorm the meaning of energy, potential energy and kinetic energy 2. Toss a beach ball up and say “kinetic”. Catch it and say “potential.” Repeat again. Toss the beach ball to a student and say “kinetic.” Prompt the student to say “potential.” Allow students to toss the ball around a few times saying “kinetic” and “potential” at the right times. 3. Now have students write down their ideas in their scientist’s notebook including examples of potential and kinetic energy (under beginning ideas) 4. Ask students what they wrote and write all ideas on the board, accepting all ideas. 5. Come to a consensus as a class as to the meaning of potential and kinetic energy and good examples of each. 6. Ask students “Are (gravitational) potential and kinetic energy related?” “How?” Have students write in their scientist’s notebook how they think potential and kinetic energy are related. Discuss. Now ask them “How can we know they are related?” Test it, of course! 7. Now tell students they are going to design a lab to test how potential and kinetic energy of balls are related. |
| **EXPLORATION**   1. Divide students into groups of 3-4 people. 2. Use the student handout to guide scientific method and direction of experiment. This is to be glued into their science interactive notebook (if you use notebooks). Go over the entire student handout explaining what is to be completed first. 3. A Hypothesis is recorded for five different heights. Make sure this is done for everyone in groups before each group designs their procedures for the experiment. 4. Students design an experiment to answer the following question. 5. “If the ball is held at \_\_\_\_\_\_\_\_cm high, it will bounce to \_\_\_\_\_\_\_\_\_ cm high. ***GLE 0507.Inq.1 Explore different scientific phenomena by asking questions, making logical predictions, planning investigations, and recording data*** and ***GLE 0507.Inq.2 Select and use appropriate tools and simple equipment to conduct an investigation.***    * + Pick five different heights to test – some higher and some lower - that are at least 10cm apart. Students will have five hypotheses statements, one for each height.      + The starting height of the ball and its bounce are the controls (what all other bounces will be compared to).  * The independent variable is the starting height and the height of the bounce is the dependent variable. This information will be discovered   + - Once the design and hypotheses are approved, give each group a ball to begin the lab     - Provide an example of what the data table should look like      1. **Participation in the Laboratory Activity**    * + Students begin experiment      + Monitor the process of carrying out the experiment and the recording of data      + Students write their observations along with their data in their scientist’s notebook  * After collecting data and writing their observations, students graph their data. ***GLE 0507.Inq.3 Organize data into appropriate tables, graphs, drawings, or diagrams.*** |
| **EXPLANATION**   * **Writing Personal Meanings**   In the conclusion section, students write an explanation of their results that include the statement. “I can conclude that the greater the potential energy, the \_\_\_\_\_\_\_\_ the kinetic energy because when the ball is dropped from a higher height, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The less the potential energy, the \_\_\_\_\_\_\_ the kinetic energy because when the ball is dropped from a lower height, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.”   * **Share Data with the Groups**  1. Next students compare their findings with the other groups by writing their statements on the board, on group white boards, or on butcher paper. ***GLE 0507.Inq.4 Identify and interpret simple patterns of evidence to communicate the findings of multiple investigations.*** 2. Group discussion of results  * Once findings are shared between groups, a comparison with the scientific community is next. |
| **ELABORATION**   * **Compare Findings to Scientific Community** * ***GLE 0507.Inq.6 Compare the results of an investigation with what scientists already accept about***    + - Present the Brain POP clips to the whole group.     - <http://www.brainpop.com/science/energy/potentialenergy/>     - <http://www.brainpop.com/science/energy/kineticenergy/>     - Scaffold a group discussion of results comparing the clip to what they concluded to. * **Individual Reflection**    + - In the Reflection portion of their lab, students compare their hypothesis with their findings and write down how their ideas have changed and if they have any more questions     - After comparisons are made, students write in their scientist’s notebook, the best explanation of what they learned in the Writing section     - It is important for students to write their opinions of the experience in their scientist’s notebook as well. To help guide students, I wrote four questions on the board to prompt writing.  1. What did you learn from this lab? 2. How did your thoughts change from when we made our hypothesis to now? 3. What did you like best about the lab and why? 4. What did you like least and why? |
| **EVALUATION**   * **Post-Instruction Understanding**   + - Reading students’ Reflection and Writing portion of the lab can indicate student understanding.     - Other assessments may include a quiz over potential and kinetic energy that includes how students know what they know or have students make a prediction based on their data how high their ball would need to be held in order to bounce as high as a basketball goal. |